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ABSTRACT

The Learning in Science Project (Primary)--LISP(P)--investigated the ideas and interests about spiders held by 8- to 10-year-old children. Data included 303 questions--and answers to some of the questions--about spiders obtained from children in four classes and from responses obtained during individual interviews with 10 children from each age level. The interviews consisted of two parts, an "interview-about-instances" (IAI) format to determine the ability of children to identify spiders and an interview to determine children's ideas about several aspects of the features and function of spiders. Responses are presented, analyzed, and discussed in separate sections representing areas considered to be of interest to teachers. They are: spider identification; spider activities; spider webs; spider habitats and retreats; food; poison; keeping a spider in school; and reaction to spiders. Other areas addressed include children's meanings for and ambiguities about words, use of analogy by students, and their sources of information about spiders. Findings indicate that spiders are an interesting and suitable topic for this age group, and that teachers can use children's ideas as a starting point to help them move closer toward the scientist's view of spiders. IAI cards and interview questions are included in appendices.) (JN)

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LEARNING IN SCIENCE PROJECT (PRIMARY)

PUPILS' VIEWS ABOUT SPIDERS

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Working Paper No. 123

PUPILS' VIEWS ABOUT SPIDERS

Eleanor Rawe

April 1984

A Working Paper of the Learning in Science Project (Primary) No.123

INTRODUCTION

"The present research has confirmed that:

(i) children have strongly held views about a variety of topics in science from a young age and prior to learning formal science;

(ii) children's views are often different to scientist's views, they are frequently not well known, and to children they are sensible and useful views ..."
(Osborne, Biddulph, Freyberg and Symington, 1982))

This paper reports on an investigation into views children hold about spiders. It is a topic which has been found to be of interest to children (Biddulph, 1982), within their range of everyday experiences, popular amongst teachers (Biddulph, Osborne and Freyberg, 1983) and for which some primary school material already exists (New Zealand Department of Education, 1980). The investigation was looked upon as a precursor to developing additional teacher guide material based on the interests and ideas of children in this area.

THE INVESTIGATION

It was decided to approach the task of identifying children's ideas and interests in two ways. First, children's questions about spiders and their answers to some of these questions were obtained from four classes of 8 - 10-year-olds. Second, interviews were conducted with ten children from each of these age levels. (Thirty children in all.)

1. How the children's questions and answers were obtained

Four overhead projector transparencies depicting two spiders, a nest of spiderlings and a spider on its web were shown to the children to elicit their questions. This resulted in 303 questions being gathered with some overlap in questions between classes. Written answers were provided by the children to one common question that was variously worded but which in effect was : "Why do spiders have webs?" Their written responses to a variety of other questions were also collected.

2. The interview schedule

After consulting various sources (e.g. the children's questions; Biddulph, 1982; Science Syllabus and Guide, 1978; Spiders - Science Resource Unit, 1980; colleagues) it was considered appropriate to develop a two-part interview schedule as follows:

PART I - An interview-about-instances to determine the ability of the children to identify spiders. (See Appendix A for the picture cards and approach used.)

PART II - An interview about important aspects of the features and function of spiders to identify the children's ideas about these. (See Appendix B for the aspects and approach used.)

Collection of information took place over a five week period in late February to late March, 1984, in one urban and three rural schools.

CHILDREN'S IDEAS AND QUESTIONS ABOUT SPIDERS

The summary of findings which follows describes some of the ideas held by the 8 - 10-year-old children interviewed which are considered to be of interest to teachers. These include ideas about identification, spider activities, webs, habitats and retreats, food, poison, reproduction and growth, and how to keep a spider. The children's stated reactions to spiders are also reported. A sample of the questions which children at the same ages asked about spiders are included to further illustrate the children's ideas and also to indicate their interests in various aspects of the topic. The majority of the 8-year-olds interviewed had recently viewed a nursery of spiderlings in their classroom and two of the 10-year-olds had participated in a class spider study the previous year. No other children appeared to have had recent class learning experiences in this area.

1. Identification

Seven pictures, three of which were spiders, were presented to the children to group as spiders or non-spiders. (See Appendix A.) If they were unable to decide whether or not the animal depicted was a spider, a third pile of 'not sures' could be made. They were then asked for their reasons for their classifications.

From a total of 210 responses, 197 were correct, 5 incorrect and 8 unsure. The incorrect and unsure responses were evenly spread among the age groups and between the pictures. Grounds for making decisions were fairly common with all the children. Reasons given for classifying the non-spiders as such included leg features (23 responses),

"only got six legs." (10 years)

body characteristics and shape (14 responses),

"Oh spiders don't have, 'cause their back part is bigger than their front ... those two are just on equal, the same size." (8 years)

and the fact that spiders do not have wings (27 responses),

"that one there's got wings and spiders don't have wings." (10 years)

tails (26 responses).

"'cause spiders do not have scorpion tails." (9/1)

or "nippers"[1] (23 responses),

"'cause spiders don't have those things that cut, nip you with on the end". (9/5)

Many of the pictures showed animals with these features. Conversely, nippers[2] were mentioned as characteristics of spiders (23 responses), children specifically indicating the two pedipalps between the top legs.

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1. Variously referred to as claws, antennae, nippers, clippers and those things there. Children repeatedly pointed to the claws on the crab and scorpion.
2. Again referred to as nippers, antennae, antlers and those things there (children pointing).

"they've all got those little ah ... little feeler things (pointing) there, out of their heads." (10 years)

All children responded that various features relating to legs determined a spider,

"All his legs are joining in there (indicating the top part of the body) and he's got one, two, three, four, five, six, seven, eight (legs)." (8 years)

and 18 mentioned body chracteristics.

"it's got two parts to its body." (8 years)

"it's got the proper shape of a spider." (9 years)

Spiders are generally recognised by their eight legs extending from the head/chest area, their two body parts, and by their two pedipalps. Most of the children appear therefore to have an accurate idea about what is or is not a spider, and have clear and fairly consistent criteria to apply in their determination of this.

The children's questions which related to identification and appearance revealed that they wanted to know why spiders have their various features.

"Why do spiders have eight legs/furry legs?"

"Why do spiders have eyes at the back of them?"

Questions such as these also tell us something about the ideas the children have about spiders.

2. Spider activities

At the beginning of the second part of the interview schedule, the children were invited to respond to the general question : "What things do you think spiders do?" Twenty-five of the children said that they build webs.

"They spin webs." (10 years)

and 21 that they catch flies, food, or prey (21 responses)

"They catch lots of flies and things." (8 years)

"... wait for their prey." (9 years)

Other ideas offered by a few of the children included:

(i) suck blood,

(ii) bite,

(iii) crawl or walk round.

SPECIAL NOTE:

The children's responses to the more specific interview questions which followed indicated that they treated spiders as a homogeneous group. There are, however, over ten behaviourally different groupings of spiders alone as listed in the chapter headings in Forster and Forster's (1973) book 'New Zealand Spiders : An Introduction'.

Occasional references were made by the children to what was seen as an exception to their generalized view,

> "Yes I think so (that all spiders make webs) but I don't really think daddy long-legs do." (8 years)

but only two children appeared to be consciously aware that different spiders have different ways of coping with their environment and different needs.

> "depends what spider you've got really ... 'cause different spiders have different things you need (to keep them alive in a terrarium)." (U years)

The majority saw spiders as animals that exhibit similar behaviours and they tended to over-generalize about them. A typical over-generalization was that of a 10-year-old who said,

> "Oh, I think all of them make webs." (10 years)

3. Webs

Although much of the information gathered from the children in this area over-lapped with their ideas on food and homes, it is possible to deal with some aspects separately.

All the children, except one, were aware that spiders which make webs fashion these from silk, thread, web material, or sticky stuff, emanating from their body:

"the string or whatever you call it." (8 years)

"they've got um kind of um chemical kind of thread." (9 years)

"a kind of webby stuff." (10 years)

In answering questions about the purpose of webs 29 of the 30 children correctly identified their prime function as that of ensnaring prey.

"the web is for to catch its prey." (9 years)

Nineteen children also said that a web was the spider's home, a response which will be discussed further on.

"To live in (a web)." (8 years)

"... for to have a place to live." (9 years)

Identifying the actual locations of webs posed no problems. All children were able to name specific and general locations both indoors and outdoors. The specific locations were places where children had seen webs, for example, on the

"tennis court fence." (9 years)
and
"deer gates." (9 years)

Five even went so far as to state that webs could be made by spiders anywhere.

Reasons for their location revealed a range of ideas. Proximity to prey, which matches the expert's view, was the most common reason (14 responses),

"'cause that's where the flies and insects will usually come." (9 years)

followed by up high, in sheltered and protected places (11 responses),

"... because its a kind of high place for them ... people couldn't kind of bang into it." (8 years)

The availability of corners or places to attach the web was a further reason offered by eight of the children.

"there's walls around it that, where they can join their web on." (9 years)

The interview questions about webs had mainly probed the children's ideas about the how, where and whys of web building. The children's questions relating to webs also showed that they were interested in these aspects. For example,

"Why do they spin a web?"
"How do spiders spin webs?"
"Why do they spin webs on trees?"

In addition, the children had other more specific inquiries about webs.

"Do spiders get stuck in their own web?"
"Why can't flies see the spider's web?"
"Why do they have different patterns on their webs?"

4. Habitats and retreats

When asked the question "Where do spiders live?" a total of 93 responses were gathered. These referred to both the habitat and retreat of the spider and were of a generalized nature,

"Oh they just about live anywhere." (9 years)

and specific nature:

"Ah some live on the beach, some are in houses, some are in little trees." (9 years)

Spiders in reality will live in any place where there is enough food to support them (Forster and Forster, 1973). The availability of prey was mentioned by 14 children, as a reason for the spiders living where they do,

"Where most flies are." (8 years)

Children who interpreted the question to mean where a spider has its home or retreat, gave responses such as "in the webs in cracks" (9 years). Little distinction was made by the children between the spider's habitat and its retreat.

When asked for the location of a spider's 'home', 19 children specifically stated that web building spiders do live in or on their webs, using them as a home.

[What are their homes like?]"... um, webs, webs, but they're very small." (8 years)

A further six children qualified their answers relating to webs and spiders, for example,

"Well I suppose they live around it (the web) but not in it or something ... they'd probably live in a corner of something ... under a branch or a hole in a tree." (8 years)

"they live in little holes ... the web's just its catching place." (10 years)

and seven children specifically mentioned the existence of underground, earth and ground dwelling spiders.

"I watched this film about spiders or something and he lived underground ... he came out the cap, out of the ground ..." (10 years)

"... just be under something like a log or a rock or something." (10 years)

Questions which interested children in this area included:

"Why do they usually live in dark places?"
"What habitat do spiders like the most?"
"Where is the most common place to find a spider?"

5. Food

To the question "What do spiders use for food?" All the children referred to one or more of the following: Flies, (which they mentioned independently of insects), insects generally, specific insects and "flying insects".

"Oh wasps, flies, mosquitoes, moths, insects ..." (9 years)

Twenty-one children were aware that spiders eat other spiders.

"... they can eat their own kind, other spiders." (10 years)

Other particular small animals such as worms and birds were mentioned by a few children as other sources of food. This latter idea was gained by four children from an 'Our World' television programme. One 10-year-old, for example, explained what she had seen.

"Some spiders, they catch birds ..., the tarantula spiders ... and they climb up trees and choong! [demonstrates] like that."

Of the 29 children who thought that spiders use webs to trap their food, nine said that this was the only means that spiders had of obtaining food. The remaining 20 discussed spiders which were also capable of jumping, grabbing and catching their prey. For example,

"If they see a fly they creep up and they grab it." (8 years)

"They just run after them and try to catch them." (10 years)

When asked to describe specifically what a spider does with its prey when it has it in its web or has caught it, a range of ideas were put forward.

Table 1: Children's responses to the question:

What does a spider do with its prey when it has caught it?

	Eats it like we do	Sucks it (blood or juice)	Poisons and eats	Poisons and sucks	Wraps it in silk & eats	Wraps it up and sucks	Poisons wraps and eats	Poisons wraps and eats
8 years	2	6				2		
9 years	2				3	1	3	1
10 years	1	1	1		1	3	3	
	5	7	1	0	4	6	6	1

Written answers provided by one standard four class (10-year-olds) to the same question revealed ideas very similar to the interview responses.

"They poison it and then eat it."
"They spin a web around it and suck all the blood out of it."

Taken together, the children's responses suggest that they have interpreted the spiders actions in a way which is close to what experts believe happens. Most spiders use poison to subdue their prey and then begin pumping digestive enzymes from lobes inside the abdomen into the prey to break down the solid portions of the body into a liquid form. Simultaneously the spider's strong sucking stomach draws the juice from the prey through its mouth and into its stomach. The prey can also be squashed by the fangs and legs to help reduce the inner material into a

soft suckable pulp. (Forster and Forster, 1973, p.24.) The hard indigestible material and the exterior are left. Spiders can also wrap their prey in silk following the injection of poison to further entangle it, thus preventing escape, and to help in storage of the prey in the spider's retreat. (Forster and Forster, 1973, p.163.)

Questions which the children would like answered in relation to food included,

> "How long does it take a spider to eat a fly?"
> "Do spiders eat everything they catch in their webs?"
> "Why do spiders suck the blood and why don't they eat the whole insect?"

6. Poison

The majority of the children (24 responses) thought that some spiders, but not all, have poison. The 'exotic' types such as the tarantula and black widow were frequently mentioned as being poisonous, and occasionally the katipo.

> "There's a couple of spiders in New Zealand that are poisonous ... the kakapo or something." (9 years)

Common garden and house spiders were considered to be free of poison.

> "No ... they wouldn't, even if they look vicious, they wouldn't have poison in them." (8 years)

Only three children expressed a view which matches that of the experts in this area.

> "I think they are all (poisonous), but most of them aren't deadly ... they're not deadly to people." (10 years)

Children's questions showed a curiosity about poison, for example,

> "How do spiders get their poison?"
> "Do all spiders have poison?"
> "How many poisonous spiders are there in New Zealand?"

7. Reproduction and Growth

No child was able to tell how spiders procreate. The following are examples of their varied responses.

"The mother spider eats the male spider and it just lays the egg from eating it, the um male spider." (8 years)

"Well two spiders would mate." (9 years)
(but she didn't know how)

"Um, oh, I dunno." (9 years)

"Might be daddy spiders." (10 years)

In reality the male spider makes a sperm web into which he deposits his sperm. He then dips his pedipalps into the sperm and these are inserted into the female to allow fertilization of her eggs. Twenty-three of the children had identified the pedipalps as noted earlier, calling them nippers, antennae and so forth but they were obviously unaware of their function in the reproduction process.

Twenty-four of the children stated that spiders lay eggs. The remaining six in the sample claimed that baby spiders are born alive "same as us." (9 years)

The expert's view is that the eggs are laid by the female spider onto silk material which is made into an egg sac. The female can then either carry it around until the eggs hatch (wolf spider), place the egg sac into a nursery web when hatching is imminent (nursery spider) or cover the sac with silk after placing it on a branch, wall, or suitable object, thus making a nest. The children interviewed did use the terms sac, nursery, nest and web stuff to describe where the female spider keeps her eggs, but did not make any of the distinctions just outlined. The terms were used interchangeably to describe a common phenomenon. If unable to recall such a term, children tended to provide a description, for example,

"It's kind of um ... a diamond shape and the bit of grass growing through the middle and all the eggs are in that." (8 years)

Children were most familiar with the nursery webs as described above, and they frequently assumed that the spider's eggs were laid directly into such webs.

Typical of the questions asked by the children in the area were:

"Do all spiders get laid in eggs?"
"How can you tell the male from the female?"
"How do spiders mate?"
"How are spiders born?"

Many specifically asked about egg sacs, nests and nurseries.

"Why do spiders make a thick web over their eggs?"
"How do spiders make their egg sacs?"
"Why do spiders carry their eggs on their back?"

Children were aware that spiderlings grow into adults but were vague as to how this happened. Comments such as "they're just like us" (9 years) and "when they eat they get fatter tummies and they grow like other people" (8 years) were common. Forster and Forster (1973) state that spiders grow by moulting at varied intervals, with the method of shedding their skin being fairly similiar among species. Only two children (9 years, 10 years) knew that spiders moult.

"I think they're kind of like caterpillars. They'll shed their skin every year or something like that and then they get bigger."
(9 years)

Questions posed by the children about growth revealed similar ideas and interests to those revealed during the interviews. For example,

"Are some spiders bigger because they eat more?"
"What is the skeleton on the outside for?"

8. <u>How to keep a spider</u>

The question "If you were to keep a spider in a terrarium at school, what sort of things would you need to do to look after it?" revealed only two response categories of note. Every child mentioned food as a necessity.

"Well I think he'd need a lot of flies and flying insects."
(10 years)

Either separately or as groups of things, leaves, twigs, grass, branches and wood were mentioned 32 times by the children as needs of spiders. These were included to enable a spider to "spin its web" (8 years), "walk around in" (9 years), "so it feels like home" (9 years), and "for it to go to sleep in" (10 years). There were no other double figure responses, and only seven children mentioned the essential requirement of water or moisture.

9. Reactions to spiders

Many people are known to have negative feelings towards spiders so the children were asked how they felt about them. Fifteen stated that they did not like spiders. Some of the reasons for this view were that they were "creepy" (10 years) and "yuk" (10 years). On the other hand, the fifteen remaining children said they either liked or were indifferent towards them.

> "I think they're all right, but they're not my favourite animal." (8 years)
>
> "... the black furry ones, I like them. I just kind of keep them in my hand and pat them." (9 years)
>
> "Ah yeah, they're all right. They're good for catching flies." (10 years)

The qualification which most children used was:

> "I like the ones that aren't poisonous (to humans)." (10 years)

Although one wonders how they can tell which ones are poisonous and which are not!

10. Children's other questions

Looking at the children's remaining questions, they appeared to be interested in the biggest/smallest spiders in New Zealand and the world, enemies of spiders, features of their anatomy and the number and variety of species. There were also questions relating to specific interests of particular children.

> "How many stomachs does a spider have?"
> "How long do spiders live?"
> "Can spiders swim?"
> "Why are spiders so cunning?"
> "Where was the first spider made?"

OBSERVATIONS

1. Word meanings and ambiguities

Both during and after the interviews it was evident that children had different meanings for, and understanding of, particular words, both among themselves and with the interviewer. Silk, web, nursery and nest were used interchangeably and taken to mean the same or similiar things. One child (8 years) saw the term "web" as applying to a place to "hatch the babies in and live in" without attaching any food catching function to it. Her subsequent description of a "web", "they look round ... they're sometimes shaped like a diamond ... there's two sides and they might live between them," resulted in the interviewer concluding that she was referring to a nursery for spiderlings. Children showed a lack of awareness of specific distinctions in this area and often attributed specific behaviours, for example the use of nurserywebs, to all spiders.

A similar semantic problem emerged in discussions about food. To 14 of the children the word 'eat' encompassed the sucking activity,

> "... just eats it ... it just sucks with its mouth."
> (10 years)

and they assumed that the interviewer knew they really meant suck. To the other 16, however, the word 'eat' meant a chewing-action in a manner similar to that of humans, with food being placed in the mouth by hand-like structures and chewed with teeth. A spider will "take out the pieces they don't like eating and eat the rest ... pick up the food and put it in its mouth." (9 years)

Ambiguities in meaning also arose with the usages of the words 'home' and 'live'. A location where spiders 'live' did not, to some children include the concept 'home',

> "Some of them live in normal places, like the city and the country, and some live in the desert, some live in the forest, some live in caves." (10 years)

although its home may well be found there. To other children however the question 'where do spiders live?" produced replies such as, "um webs" (8 years) and "in the webs", "underground" (9 years) as the question was interpreted to mean where is the spider's home.

These semantic confusions and ambiguities in meaning have implications for teaching. Teachers need to make clear their own meanings to avoid misinterpreting children's responses and children misunderstanding teacher statements.

2. Terminology

As the Department of Education Unit on Spiders points out, (1980, pp 5 and 6), there are many ways in which different spiders use silk, and these products and functions have specialized names, for example, signal line, sac and drag line. In some cases the children were unaware of the functions; in others they lacked the correct terminology.

> "That, um, ah, that, it's sort of , but I can't remember the name for it, stuff that the web's made out of." (10 years)

> "... All the ones that hatch make this little parachute kind of thing and they fly away." (10 years)

These children were describing silk, and the ballooning of nursery web spiderlings where silk is used to 'catch' the wind and transport them through the air.

3. The use of analogy

Analogies were commonly used in reasoning and in supporting explanations.

> "Well, we eat, they must eat ... over the years they get bigger and then they eat ..." (8 years)

> "I think they're kind of like caterpillars, they'll (spiders) shed their skin ..." (9 years)

were typical of the analogies with people and other animals that the children used. Some children used analogies to support an answer or idea, or when unsure attributed known behaviours or characteristics to the unknown.

"... same as us (how a spider has babies) ... every um seven months or so." (8 years)

"I don't know. Just like us, we can go away from our houses..." (9 years)

On the birth of baby spiders, one boy (8 years) made the following observations,

"... they one by one come out, something like our fitch ... something like our cows. If you go near them when they're having their um calf, the calf goes back in and she doesn't have it for another year."

The analogy can be based upon a somewhat doubtful or confused idea; and result in unusal ideas being held in this case about cows, and now spiders.

4. Sources of information

When asked how they knew so much about spiders, first hand observation, books, television, family members and school all featured prominently as information sources about spiders. Three children also saw themselves as creators of information:

"I just think it up when people ask me." (8 years)

Often such "guesses" do have a basis in existing ideas, albeit tacit knowledge.

Many children during the interviews also related specific experiences that they had had with spiders and used these to illustrate and support their ideas.

"there was this big branch and there was a cobweb around it, it was a white one, a dark white one and um ... the babies go in here, there's a little hole ..." (8 years)

CONCLUSION

The opening general question "What do spiders do?" initially indicated that the children had a rather superficial view of spiders, seeing them mainly as web builders and catchers of prey. An examination of the information gained from the subsequent interview questions, however,

clearly showed that the children were aware of many other features of spider's lives and did have ideas about how and why they behave as they do.

The children's ideas diverged from those of the expert mainly in the areas of reproduction and growth, retreats and their location, and the presence of poison in spiders. In all other areas investigated, the children's ideas and interpretations of spider behaviour were the same as, or moving towards, those of the expert.

As exemplified earlier in the quote "Oh I think all of them make webs" (10 years) the children overgeneralized and this somewhat limited their options. Ideas they had were often true for one type of spider, and in that respect were similar to the view of the expert, but did not hold true for all spiders.

On the basis of this investigation, it would appear that Spiders is an interesting and suitable topic for study by eight, nine and ten-year-old children. Many have had first hand experiences of them and display a great interest in, and curiosity about them. Teachers can capitalize on this and use the children's ideas as a starting point for their investigations, helping them to move closer towards the expert's view.

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Tamahere Model Country School,
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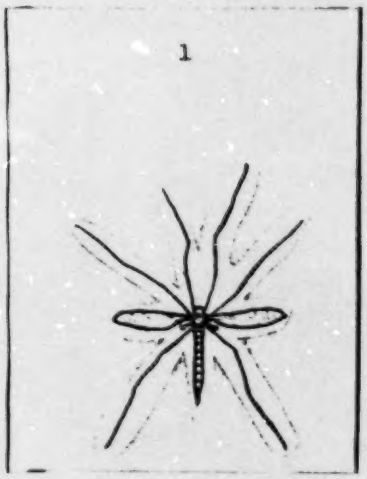
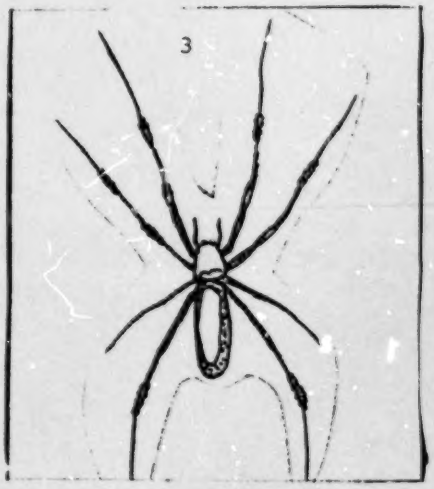
APPENDIX A

Cards used for interview-about-instances





APPENDIX B

Interview Schedule

A. I would like you to arrange these pictures into a group of things that you think are spiders, and a group that you think are not spiders.

In the way that you think about spiders, why is this a spider / why isn't this a spider?

B. What things do you think spiders do?

C. Webs

How do you think spiders make their webs?
What do you think a spider's web is for?
Do you think all spiders make webs?
Where do you think spiders make their webs?
Why do you think they make their webs there?

D. Food

In what ways do you think spiders get their food?
What things do you think that spiders use for food?
What do you think a spider does with its food?
How do you think it does this?
Do you think spiders eat other spiders?

E. Poison

Do you think all spiders have poison in them?
Do you think spiders are poisonous?
What are they poisonous to?

F. Habitats and Retreats

Where do spiders live?
Why do you think they live there?
Do you think spiders have a home?
If so, where do you think they have their home?
Why do you think it is there?

G. Reproduction and Growth

How do you think we get new spiders?

What do you think happens next?

Do you think that spiders grow?

How do you think they grow?

H. General

Are there any ways in which you think a spider can be useful?

- to whom?
- how?

What do you think would happen if there were no spiders in New Zealand?

Do you like spiders?

Why / why not?

Where do your ideas about spiders come from?

or How do you know so much about spiders?

If you were going to keep a spider in a terrarium, what things do you think you would need in order to look after it?

These questions served as guides.

Interviews often followed ideas and cues from the children, but all areas above were covered at some stage during the interview.

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